Commonwealth of Virginia

Center for Innovative Technology

Virginia Information Technology Agency
- Virginia Geographic Information Network

Virginia Tech Center for Geospatial Information Technology

NATIONAL BROADBAND MAPPING PROJECT

VIRGINIA BROADBAND MAPPING WEBSITE HELP DOCUMENTATION

A summary of processing steps necessary to move broadband provider submission into the NTIA SBDD data model and displayed using the Virginia Broadband Mapping website.

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Site Overview

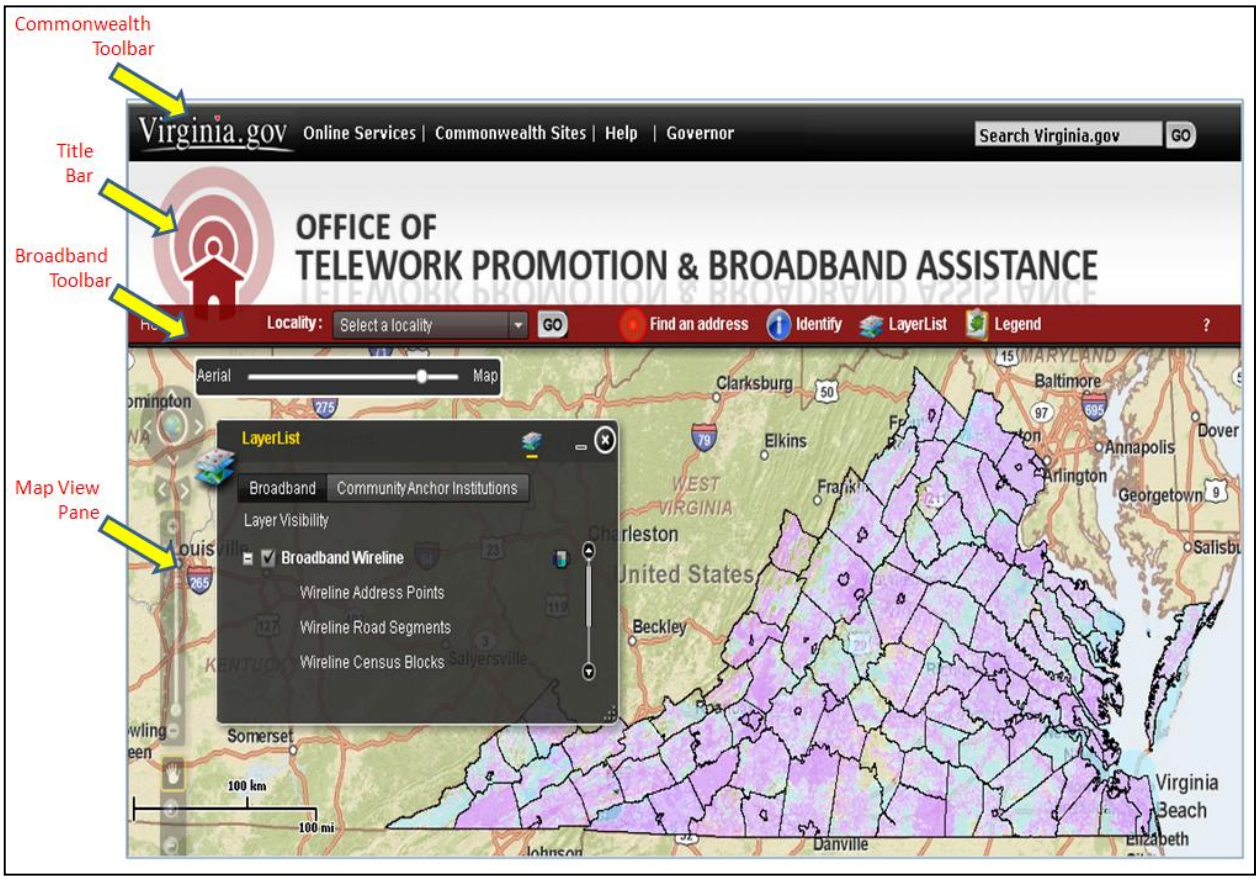
The Office of Telework Promotion and Broadband Assistance - Virginia Broadband Mapping site is designed to be easy to use while providing valuable information regarding the availability of access to the Internet at Broadband speeds. The site includes internet access in both wireline and wireless formats. The information presented on the map was compiled from all of the Broadband Internet Service Providers operating in the Commonwealth. The provider data was migrated into a Geographic Information System (GIS) and is presented in an easy to understand map.

The Virginia Broadband Mapping site has been developed as part of a Notice of Funding Availability (NOFA) released by the US Department of Commerce to support the development of data detailing broadband availability at the state level. As part of the NOFA guidelines the National Telecommunications and Information Agency (NTIA) has determined that Broadband Internet Access is the use of transmission technologies that provide a minimum download speeds of 768 kilobits per second (kbps) and minimum upload speeds of 200 kbps. The NTIA has required that broadband availability be reported by providers at a Census Block level in the denser areas of the state and either road segments or serviced addresses in the more rural portions of the commonwealth.

The mapping website provides a series of tools that allow the user to identify the type of broadband service available at any location in the state as well as the level of upload/download speeds that are available at that location. The site provides the name of the provider and the type of transmission technology available from each provider at the selected location. The site includes tools to allow the user to orient themselves in the state by address, locality or graphically using pan/zoom tools. The site allows the user to view the broadband availability in relation to a standard street map or the state wide aerial photography. The site allows the user to identify Community Anchor Institutions (CAIs) and the broadband technology in use and available to these critical facilities.

Site Layout

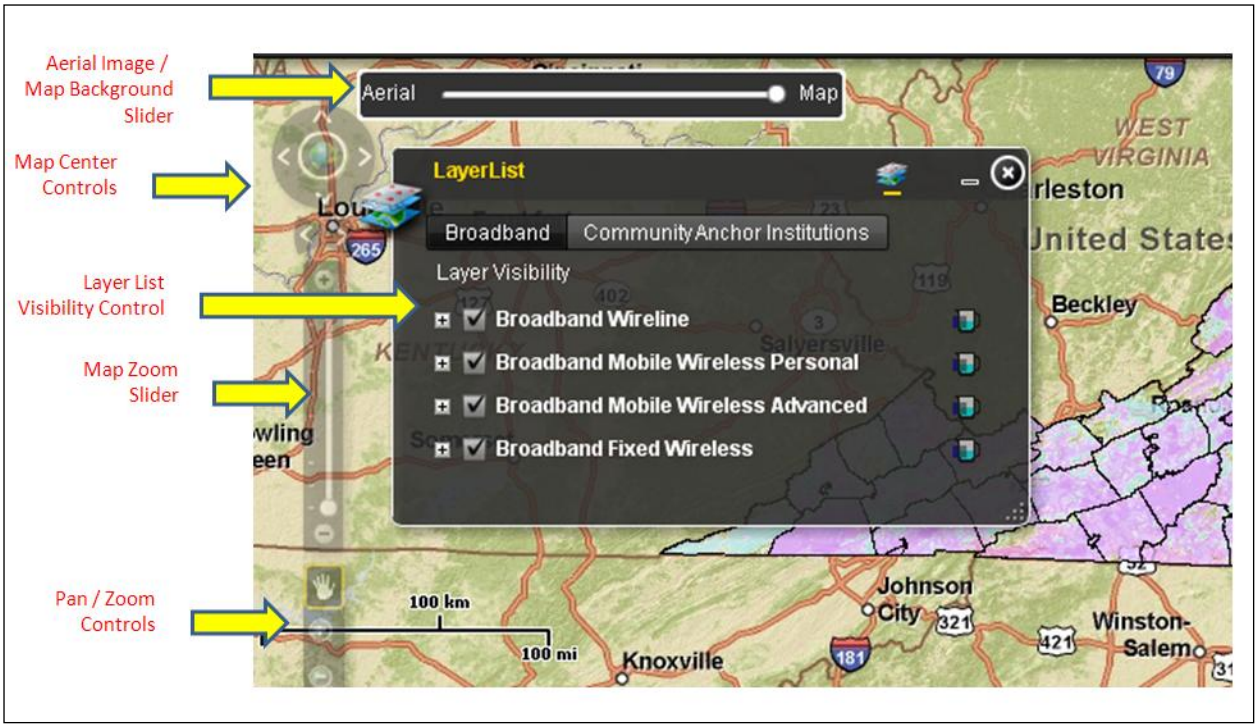
The Virginia Broadband Mapping website is broken into a series of functional areas as detailed below:



Commonwealth Toolbar	Provides access to Commonwealth of Virginia Internet Resources
Title Bar	Identifies the Office of Telework Promotion and Broadband Assistance
Broadband Toolbar	Provides tools to control, search and interact with Virginia Broadband Mapping website
Map View Pane	The presentation of the Broadband Mapping data in map form

Map View Pane

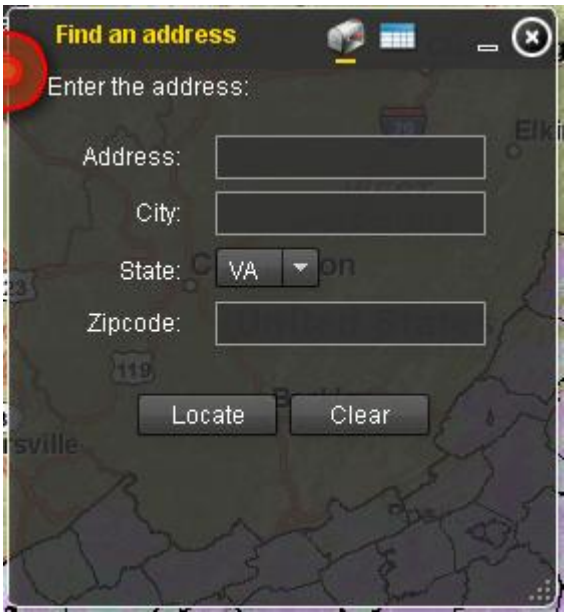
The Map View Pane tools control the way that the map looks on the website. The tools can change the part of the state that is visible, turn broadband layers on and off and control the ability to see through them. The tool also can change the background map used by the website.

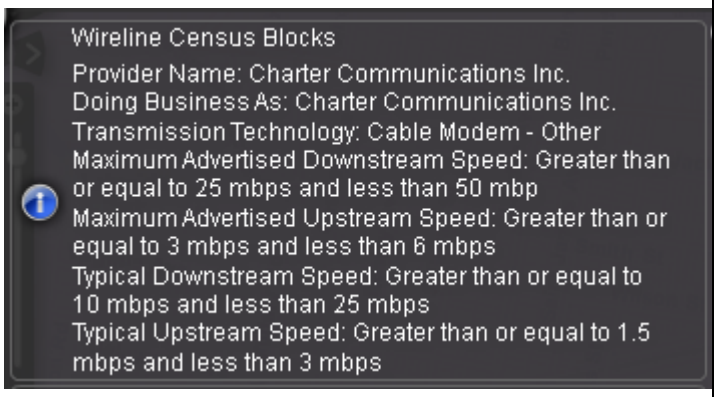
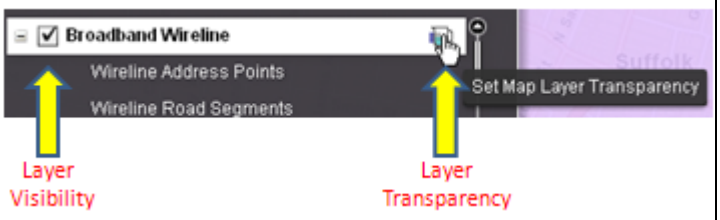


Aerial Image / Map Background Slider	Move the slider closer to Aerial to show Aerial Photography as map background. Move the slider closer to Map to show the street map background.
Map Center Controls	Pan Map Left, Right, Up and Down from current center point. Globe in center will zoom map to the extent of the Commonwealth
Layer List Visibility Control	Turn Broadband Map layers on and off. Set the transparency of each Broadband layer separately. Separate tabs for Broadband layers and Community Anchor Institutions.
Map Zoom Slider	Zoom in and out of the map quickly at fixed scales.
Pan / Zoom Controls	Recenter the map view with a click and drag. Zoom in and out of map by drawing box/rectangle.

Broadband Toolbar

The Broadband Map Toolbar provides a number of functions that allow the user to control and interact with the map. Each button is described below.

Home	Takes you to http://www.wired.virginia.gov/ Office of Telework Promotion & Broadband Assistance website
	Zoom to locality boundary Select locality name from drop-down list and hit the Go button. Map will zoom to the extent of the locality boundary and draw layers as defined in the Layer List.
	Zoom to specific address.  Enter Address: *123 N Main St.* Enter City: *Suffolk* Enter ZipCode: *23434*

	Hit Locate button to search for matches. Click on correct result record to zoom to location.
	View Broadband availability at map click location.*  *Because of search tolerance, one than one record may be returned for each feature type (Census Block, Road Segment, Address Point)
	Toggle Layer List visibility. The layer list provides control over map layers shown and their transparency level. To turn a map layer on place a Check in the selection box to the left of the layer name.  To make the layer transparent, click the Layer Transparency button and move the slider to the desired level of opacity. Click the X to dismiss the transparenct slider. Click Community Anchor Institutions tab to control visibility of CAIs.
	Display Static Map Legend
	Display website Help (this file)

Transmission Technologies Defined

The NTIA includes several different technologies of transmission in the National Broadband Map submissions. Below is a description of each of the technologies.

Source - http://www.broadbandmap.gov/classroom/technology

Asymmetric xDSL	Digital Subscriber Line (DSL) is a wireline transmission technology that transmits data over traditional copper telephone lines to homes and businesses. Users are able to connect to the high-speed Internet via a modem without disrupting their telephone service. DSL is the technology most commonly used by local telephone companies to provide high-speed data services. Asymmetric DSL, used primarily by residential consumers, typically provides faster download speed for receiving data than upstream speed for sending data. This means that it may be faster to download webpages, data or media than it would be to upload this information.
Symmetric xDSL	Digital Subscriber Line (DSL) is a wireline transmission technology that transmits data over traditional copper telephone lines already installed to homes and businesses. Users are able to connect to the high-speed Internet via a modem without disrupting their telephone service. DSL is the technology most commonly used by local telephone companies to provide high-speed data services. Symmetric DSL is intended to provide equal speed for sending and receiving data. This arrangement is standard for businesses that move large files among various users and between multiple sources
Other Copper Wireline	These are other technologies that use phone lines to transmit data. Examples include T-1 and ISDN lines.
Cable Modem - DOCSIS 3.0	Cable modem service enables high-speed Internet access using the same cable television infrastructure, including coaxial cables, which deliver cable TV programming. Users can access the Internet without disrupting cable TV service. "DOCSIS 3.0" refers to Data Over Cable Service Interface Specifications. It is the current technological standard for cable modems and offers faster broadband service than older standards.
Cable Modem - Other	Cable modem service enables high-speed Internet access using the same coaxial cables that deliver cable TV programming. Users can access the Internet without disrupting cable TV service. "Cable Modem - Other" refers to cable modems which utilize versions of DOCSIS (Data Over Cable Service Interface Specifications) other than the current standard, DOCSIS 3.0
Optical Carrier - Fiber to the End	This refers to a fiber-optic-based broadband network. Fiber optic technology converts electrical signals carrying data to light and then sends the light through transparent glass fibers about the diameter of a human

User	hair. Fiber has the capacity to transmit data at speeds surpassing any other broadband technology.
Satellite	Just as satellites orbiting the earth provide necessary links for telephone and video service, they can also provide links for broadband. Satellite broadband is another form of wireless broadband and is useful for serving remote or sparsely populated areas. In some remote areas, this may be the only access to broadband service. Obtaining satellite broadband may be more costly and involved than obtaining DSL or cable modem. A user must have: • a two or three foot dish or base station - the most costly item; • a satellite Internet modem; and • a clear line of sight to the provider's satellite. As of February 2011, users may not see broadband satellite providers included in the search results page. NTIA expects to update the satellite information and include it in the next six-month update of the National Broadband Map. The following satellite providers have provided data to several states: Wild Blue, Hughesnet, Skyway.
Terrestrial Fixed Wireless - Unlicensed	This technology enables wireless broadband service to a specific geographic location using spectrum that is shared among Internet service providers. This wireless service includes WiFi and other similar technologies (*e.g.*, WiMAX and other proprietary wireless systems).
Terrestrial Fixed Wireless - Licensed	This technology enables wireless broadband service to a specific geographic location using spectrum licensed to the Internet service provider. This wireless service includes WiFi and other similar technologies (*e.g.*, WiMAX and other proprietary wireless systems).
Electric Power Line	Sometimes referred to as "Broadband over Power Lines", this technology provides broadband by using the power lines connected to a consumer's residence. Consumers must use special modems provided by the power company in order to access broadband Internet services.
All Other	Technology types listed as "other" refer to any technologies used to deliver broadband-quality speeds that are not included in the other categories listed here

Data Processing Methodology

The VA Broadband Mapping team employed a number of standard geospatial techniques for migrating data submitted by broadband service providers into the NTIA SBDD Data Model. These techniques include spatial joining, buffering and geocoding. Base data used to support the project includes:

VGIN Base Data

Virginia State Road Centerline database (RCL)

Virginia E-911 Address Point database (Addresses)

US Postal Service Virginia ZIPCode boundary layer

US Census Bureau's 2000 Census Block boundary layer

US Census Bureau's 2006 TIGER Line file

VGIN Geocoding Engines

The Virginia E-911 Address Point database was used to create a Geocoding Engine using the ESRI US Alphanumeric Ranges with City, State, and ZIP pattern. The Geocoding engine had a minimum spelling sensitivity of 80%, a minimum candidate score of 10% and minimum match score of 60%. The geocoding engine was set to allow ties to be matched. The base data used was published by VGIN March 8, 2011 and represents all locality based address points provided to VGIN.

The Virginia State Road Centerline database was used to create a Geocoding Engine using the ESRI Alphanumeric Ranges with City, State, and ZIP pattern. The Geocoding engine had a minimum spelling sensitivity of 80%, a minimum candidate score of 10% and minimum match score of 60%. The geocoding engine was set to allow ties to be matched. The base data used was published by VGIN March 8, 2011 and represents all locality based road centerlines provided to VGIN.

All processing of service provider data was conducted using ESRI File Geodatabases. All source information was imported into provider specific FGDBs and processed. All interim results were contained in the FGDBs to allow for back-tracking and reprocessing as necessary. Once complete the data was loaded into the NTIA SBDD Data Model for final quality control and delivery to the NTIA.

Provider Source Data Descriptions

Participating Broadband Provider partners made broadband availability data available to the project in various ways. These include ASCII Text Files, Excel Spreadsheets and ESRI Shape Files. The information contained in these source files ranges from all attributes prescribed by the NOFA to a list of customer telephone numbers in the form of a telephone book.

Processing Data Submitted as Address Points

Data submitted as address points was processed using the two geocoders prepared for the project. First, all submitted addresses were geocoded using the Address Point Geocoding Engine. All records that generated a match were saved for continued processing and resulted in NTIA Service_Address Feature Class records. The results were spatially joined to the 2000 Census Blocks to provide the Census Block ID for each address point.

All addresses that did not result in a location using the first Geocoding Engine were reprocessed using the Road Centerline Geocoder. Because the location of the points resulting from this geocoding effort were determined based on the address range of the road segment that was matched, the point locations were not added to the NTIA Service_AddressPoint. The geocoded points were spatially joined to the RCL road centerline that they were geocoded to and the road segment was included in the NTIA data model as Service_RoadSegment record.

Once the Address Point or Road Segment were determined the rest of the attributes necessary for loading into the NTIA SBDD Data Model were calculated for each record using Spatial Joins. Once completed, the records were added to the NTIA model using the ESRI Simple Data Loader. The option to load into a subtype was not used. Once inside of the NTIA model, all required topology and attribute quality control was conducted with errors being fixed prior to submission to the NTIA.

Processing Data Submitted as TIGER Road Segments

Data submitted as TIGER line segments was processed using attribute joins, buffer creation and spatial selections. After import into the FGDB, attribute joins were made from the 2006 Census TIGER Line file using the TLID field. All TIGER line segments with matching provider records were included in the PGDB for continued process. A 5 meter buffer was created for each TIGER Line segment and all Virginia Road Centerline segments that intersected these buffers were identified for addition to the NTIA Service_RoadSegment Feature Class. The provider attributes were transferred to the Virginia RCL segments using a spatial join with the 5 Meter Buffers.

Once the Road Segment were determined the rest of the attributes necessary for loading into the NTIA SBDD Data Model were calculated for each record using Spatial Joins. Once completed, the records were added to the NTIA model using the ESRI Simple Data Loader. The option to load into a subtype was not used. Once inside of the NTIA model, all required topology and attribute quality control was conducted with errors being fixed prior to submission to the NTIA.

Processing Data Submitted as Census Blocks

Data submitted for Census Blocks less than 2 square miles was processed using attribute joins and spatial joins. After importing into the FGBD, attribute joins were made between the 2000 Census Blocks and the provider census block records. All Census Blocks with matching provider records were included in the PGDB for continued processing. All included records were identified for addition to the NTIA Service_CensusBlock Feature Class.

Once the Census Blocks were determined the rest of the attributes necessary for loading into the NTIA SBDD Data Model were calculated for each record using Spatial Joins. Once completed, the records were added to the NTIA model using the ESRI Simple Data Loader. The option to load into a subtype was not used. Once inside of the NTIA model, all required topology and attribute quality control was conducted with errors being fixed prior to submission to the NTIA.

Processing Middle Mile Points

Middle Mile locations were submitted by broadband providers in the form of point shape file or text files and spreadsheets containing Latitude, Longitude locations or addresses of Middle Mile points. As with Broadband Service availability, all data was imported and processed inside of an ESRI File Geodatabase (FGDB).

If the data was provided as Latitude, Longitude locations, the data was processed using the ESRI Add XY location tool. If the data was provided as addresses, the data was processed using the geocoders in the same manner as service address points. Once the locations were determined via the appropriate methods, the attributes required by the NTIA SBDD data model were determined using Spatial Joins. Once complete, the data was loaded into the NTIA data model using the ESRI Simple Data Loader. The option to load into a subtype was not used. Once inside of the NTIA model, all required topology and attribute quality control was conducted with errors being fixed prior to submission to the NTIA.

Processing Last Mile Points

Last Mile locations were submitted by broadband providers in the form of point shape file or text files and spreadsheets containing Latitude, Longitude locations or addresses of Middle Mile points. As with Broadband Service availability, all data was imported and processed inside of an ESRI File Geodatabase (FGDB).

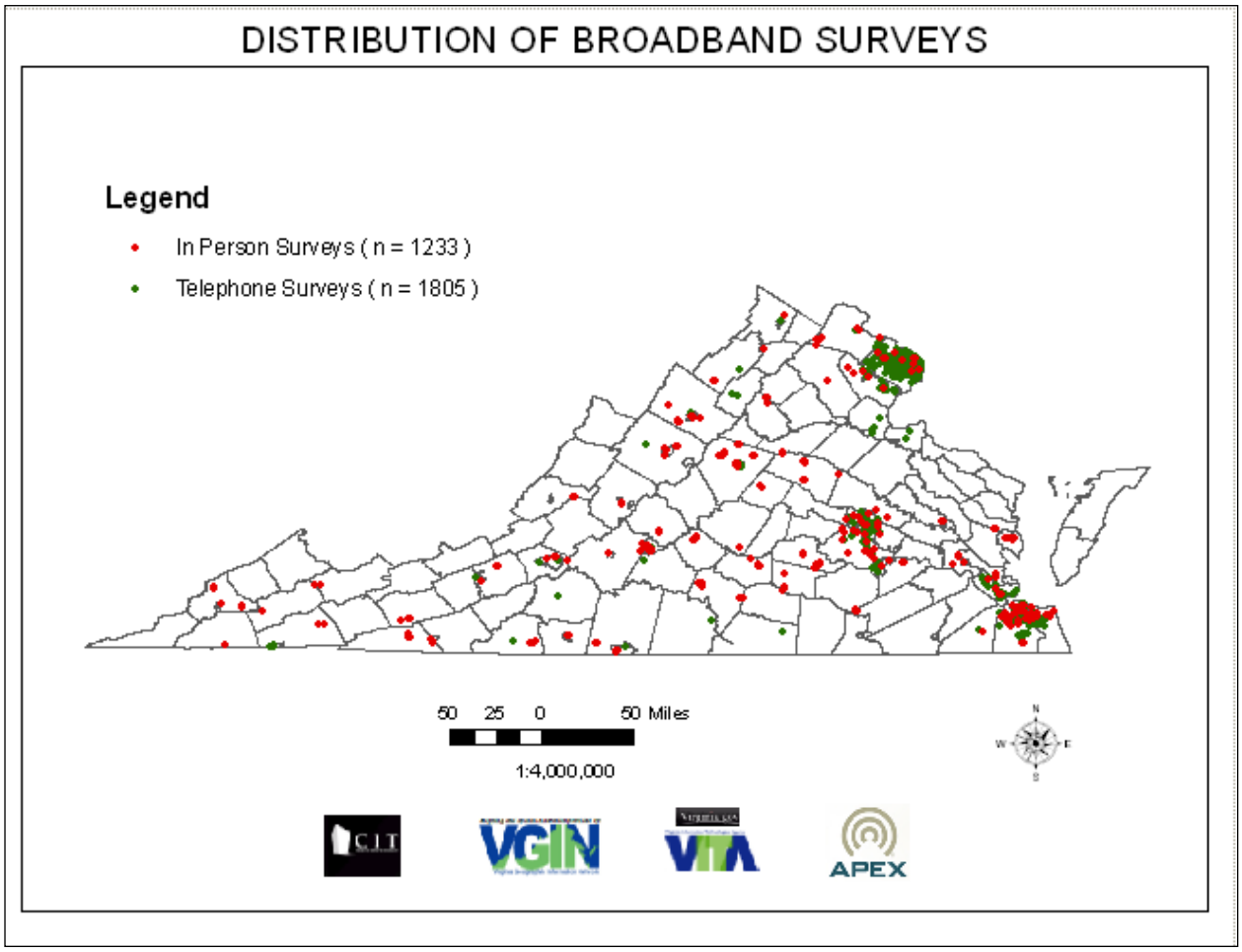
If the data was provided as Latitude, Longitude locations, the data was processed using the ESRI Add XY location tool. If the data was provided as addresses, the data was processed using the geocoders in the same manner as service address points. Once the locations were determined via the appropriate methods, the attributes required by the NTIA SBDD data model were determined using Spatial Joins. Once complete, the data was loaded into the NTIA data model using the ESRI Simple Data Loader. The option to load into a subtype was not used. Once inside of the NTIA model, all required topology and attribute quality control was conducted with errors being fixed prior to submission to the NTIA.

NO LAST MILE POINTS HAVE BEEN INCLUDED IN THE VIRGINIA SUBMISSION AT THIS TIME.

Broadband Provider Data Validation Methodology

The Broadband Mapping team includes a statistical survey company that was tasked with performing in-person and telephone surveys gauging the availability and satisfaction of Broadband Internet access for Virginia citizens and businesses. Apex Covantage conducted over 1500 broadband satisfaction surveys designed to determine broadband availability, adoption rate and user satisfaction. The survey responses were provided by both residences and businesses.

During the period of January 10 – 24, 2011, 1340 in-person surveys were attempted throughout Virginia. Of these 616 surveys were completed (45.97%). At the same time 1805 telephone surveys were conducted to gauge the same information with 100% completion. This survey activity results in a total sample size of 2421 surveys distributed throughout the state. A map showing the distribution of the survey locations is shown below.



The surveys were conducted in 85 of the 134 jurisdictions in the state. An analysis of the frequency of surveys by locality shows that the City of Fairfax led all jurisdictions with 608 surveys conducted, followed by the Arlington County (283), City of Virginia Beach (228) and the City of Alexandria (225). The selection of survey locations was designed to include communities deemed to be under-served or un-served by broadband availability as well as those communities with adequate coverage.

Analysis of the survey results are detailed below:

Analysis 1 – Survey Locations and Aggregate Broadband Service Territories

Of the 2,421 surveys conducted, 96.1% of the responses are located in areas currently identified as being served by one or more wireline broadband providers. Additionally, over 99% of the responses are located in areas currently identified as being served by one or more wireless broadband service. This high correlation between the survey locations and the aggregate broadband service areas validate that using the survey results to gauge the confidence in the provided broadband service territory is reasonable.

Table 1 - Survey Locations in Relation to Aggregate Broadband Service Territories

Total Surveys				
		In Person	**Telephone**	**Total**
	Total Records	**616**	**1805**	**2421**
Wireline	**Served by Wireline Providers**	**561**	**1765**	**2326**
	Percentage	*91.1%*	*97.8%*	*96.1%*
Wireless	**Served by Wireless Providers**	**601**	**1801**	**2402**
	Percentage	*97.6%*	*99.8%*	*99.2%*

Analysis 2 – Survey Locations Confirming Internet Access and Aggregate Broadband Service Territories

Of all the surveys, 1,856 indicated current access to the internet. This subset of surveys resulted in a population of potential broadband consumers. The majority of this subset population is located within the aggregate broadband service territory as reported by the broadband providers. Of these surveys over 96% are within the aggregate wireline broadband service territory. Additionally, over 99% of the surveys are located with the aggregate wireless service territory. This high correlation between the survey locations confirming Internet usage and the aggregate broadband service areas validate that using the survey results to gauge the confidence in the provided broadband service territory is reasonable.

Table 2 - Survey Locations Confirming Internet Access

Surveys Confirming Internet Access				
		In Person	**Telephone**	**Total**
	Total Records	**452**	**1404**	**1856**
Wireline	**Served by Wireline Providers**	**418**	**1377**	**1795**

	Percentage	*92.5%*	*98.1%*	*96.7%*
Wireless	**Served by Wireless Providers**	**446**	**1400**	**1846**
	Percentage	*98.7%*	*99.7%*	*99.5%*

Analysis 3 - Survey Locations Confirming Internet Access using Broadband Service and Aggregate Broadband Service Territories

Of all surveys, 1716 indicated that access to the internet was current using Broadband services. This further subset resulted in a population of current customers of one or more Broadband Service providers. An examination of the location of this population in relation to the aggregate broadband availability territory results in a high percentage of locations being within the stated service territory. The aggregate wireline service territory included 97.3% of the survey locations. The aggregate wireless service territory indicated availability of broadband to 99.7% of the survey locations. This high correlation between the survey locations indicating current broadband service and the aggregate broadband service areas validate that using the survey results to gauge the confidence in the provided broadband service territory is reasonable.

Table 3 - Survey Locations Confirming Broadband Service Usage

Surveys Confirming Broadband Internet Access				
		In Person	**Telephone**	**Total**
	Total Records	**417**	**1299**	**1716**
Wireline	**Served by Wireline Providers**	**394**	**1276**	**1670**
	Percentage	*94.5%*	*98.2%*	*97.3%*
Wireless	**Served by Wireless Providers**	**415**	**1295**	**1710**
	Percentage	*99.5%*	*99.7%*	*99.7%*

Analysis 4 - Survey Locations Identifying Broadband Provider and Identified Provider Service Territory

As a final analysis was conducted to validate the service territory of broadband service providers by examining survey records that identified specific providers. This analysis segregated each survey that identified a provider and compared the survey location with that providers reported service territory to determine if the survey was inside the area. The analysis resulted in 91.1% of the survey locations being within the service territory provided by the identified broadband service provider. The percentages for specific broadband service providers varied greatly, ranging from 0% - 100% of the survey locations

being validated. The results of the analysis however are directly impacted by a number of factors that can skew the percentages for a specific provider. Examples of these factors are:

- Misidentification of Broadband Provider
- Misspelling of Broadband Provider Name
- Low sample size for specific Broadband Provider
- Providers Doing Business under multiple company names
- Error in data entry
- Error in data normalization
- Error in data analysis

Table 4 - Survey Locations Identifying Broadband Service Provider

Surveys Identifying Participating Broadband Provider				
	Provider Identified	Total Survey Records	Found In Provider Service Area	Percentage
Wireless	Sprint	**370**	**341**	*92.2%*
	Verizon Wireless	**832**	**771**	*92.7%*
	Roadstar Internet Inc.	**1**	**1**	*100.0%*
Wireline	Buggs Island Telephone Cooperative	2	0	*0.0%*
	CenturyLink	18	16	*88.9%*
	Charter Communications Inc.	1	1	*100.0%*
	Comcast	97	91	*93.8%*
	Cox Communications	94	93	*98.9%*
	Cricket Communications, Inc.	1	1	*100.0%*
	MBC	1	0	*0.0%*
	MetroCast Communications	1	0	*0.0%*
	NTELOS	11	3	*27.3%*
	Nelson Cable Inc.	2	0	*0.0%*
	Shentel	10	10	*100.0%*
	TDS Telecom	2	2	*100.0%*
	Time Warner Cable	1	1	*100.0%*
	Verizon Virginia Inc.	60	36	*60.0%*
	Verizon Wireless	74	72	*97.3%*
	XO Communications Services, Inc.	2	0	*0.0%*
		1580	**1439**	***91.1%***

Summary of Data Validation

The process of data validation through the use of in-person and telephone surveys provides a high degree of confidence in the aggregate broadband service territory as reported by the participating Broadband Service Providers. The adoption and usage patterns indicated in the surveys confirm that broadband service is being used within the areas that service availability is indicated.

There are insufficient survey records, problems with the data and a lack of jurisdictional representation within the survey responses to provide the ability to determine the confidence able to be placed on any particular service availability territory. However, when examined in aggregate across all broadband service providers, a high degree of confidence can be placed in the Broadband Service data.

User Feed Back

The users of this website are encouraged to provide feedback as appropriate. The user can report a problem with the functioning or the data displayed on the site by emailing the Governor of Virginia's Office of Telework Promotion & Broadband Assistance at wired@governor.virginia.gov. When submitting questions please provide as detailed as explanation as possible. If necessary, please attach a screen capture to the Email as a JPEG image.

The Federal Communications Commission provides information detailing the National Broadband Plan at http://www.broadband.gov. This site provide details of expansion of broadband technology in the future. The site also provided the ability to test the speed of your broadband connection http://www.broadband.gov/qualitytest/. The FCC site also provides a mechanism to report a broadband deadzone at http://www.broadband.gov/qualitytest/deadzone.